I Claim:

1. A system for producing an output sound field that is representative of an input sound field, comprising:

a microphone array for receiving the input sound field and producing therefrom a microphone signal ("P_{in}") representative of the input sound field wherein P_{in} comprises B-format channels, an FL (front left) channel, and an FR (front right) channel;

an encoder for producing an encoded signal ("S_{out}") from P_{in} wherein S_{out} comprises an ITU-compatible six channel signal;

a decoder for producing a decoded signal ("P_{out}") from S_{out} wherein P_{out} comprises B-format channels, an FL channel, and an FR channel; and

a plurality of speakers for producing the output sound field from P_{out}.

2. The system of Claim 1 wherein the hybrid microphone array is comprised of:

at least 6 microphones; and

a baffle including a substantially ellipsoidal structure.

3. The system of Claim 2 wherein four of said microphones are arranged in a tetrahedron.

4. The system of Claim 3 wherein the plurality of speakers produces the output sound field from S_{out}.

5. The system of Claim 4 wherein the plurality of speakers are arranged in a 2D arrangement.

6. The system of Claim 1 wherein P_{in} and S_{out} are each a 6 x 1 matrix and the encoder produces S_{out} by multiplying P_{in} by a 6 x 6 transformation matrix ("S").

7. The system of Claim 1 wherein S comprises the quantities:

$$\begin{vmatrix} s(L,FL) & s(L,FR) & s(L,W) & s(L,X) & s(L,Y) & s(L,Z) \\ s(R,FL) & s(R,FR) & s(R,W) & s(R,X) & s(R,Y) & s(R,Z) \\ s(C,FL) & s(C,FR) & s(C,W) & s(C,X) & s(C,Y) & s(C,Z) \\ s(SC,FL) & s(SC,FR) & s(SC,W) & s(SC,X) & s(SC,Y) & s(SC,Z) \\ s(SL,FL) & s(SL,FR) & s(SL,W) & s(SL,X) & s(SL,Y) & s(SL,Z) \\ s(SR,FL) & s(SR,FR) & s(SR,W) & s(SR,X) & s(SR,Y) & s(SR,Z) \end{vmatrix}$$

wherein:

L represents a left speaker channel for an ITU-compatible six channel signal;

R represents a right speaker channel for an ITU-compatible six channel signal;

C represents a center speaker channel for an ITU-compatible six channel signal;

SC represents a surround center speaker channel for an ITU-compatible six channel signal;

SL represents a surround left speaker channel for an ITU-compatible six channel signal;

SR represents a surround right speaker channel for an ITU-compatible six channel signal;

FL represents the front left speaker channel;

FR represents the front right speaker channel;

W represents a B-format channel;

X represents a B-format channel;

Y represents a B-format channel;

Z represents a B-format channel;

and wherein

$s(\alpha, \beta)$ represents a transformation quantity relating the respective α and β channels.

8. The system of Claim 7 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.736	0	.425
0	0	.601	−.736	0	.425
0	0	.601	−.368	.638	−.425
0	0	.601	−.368	−.638	−.425

9. The system of Claim 7 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.736	0	−.425
0	0	.601	−.736	0	−.425
0	0	.601	−.368	.638	.425
0	0	.601	−.368	−.638	.425

10. The system of Claim 7 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.736	0	.425
0	0	.601	−.425	0	.736
0	0	.601	−.425	.736	0
0	0	.601	−.425	−.736	0

11. The system of Claim 7 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.850	0	0
0	0	.601	−.425	0	.736
0	0	.601	−.531	.638	−.184
0	0	.601	−.531	−.638	−.184

12. The system of Claim 7 wherein S comprises the following approximate quantities:

$$\begin{vmatrix} .850 & 0 & 0 & 0 & 0 & 0 \\ 0 & .850 & 0 & 0 & 0 & 0 \\ 0 & 0 & .601 & .425 & 0 & -.736 \\ 0 & 0 & .601 & -.850 & 0 & 0 \\ 0 & 0 & .601 & -.106 & .638 & .552 \\ 0 & 0 & .601 & -.106 & -.638 & .552 \end{vmatrix}$$

13. The system of Claim 7 wherein S comprises the following approximate quantities:

$$\begin{vmatrix} .850 & 0 & 0 & 0 & 0 & 0 \\ 0 & .850 & 0 & 0 & 0 & 0 \\ 0 & 0 & .601 & .850 & 0 & 0 \\ 0 & 0 & .601 & 0 & 0 & .850 \\ 0 & 0 & .601 & -.368 & .736 & .213 \\ 0 & 0 & .601 & -.368 & -.736 & .213 \end{vmatrix}$$

14. The system of Claim 6 wherein P_{out} is a 6 x 1 matrix and the decoder produces P_{out} by multiplying S_{out} by the inverse of S.

15. The system of Claim 1 wherein the plurality of speakers are arranged in a 3D arrangement.

16. The system of Claim 15 wherein the plurality of speakers is ten.

17. The system of Claim 16 wherein:

a first two of said speakers are positioned so that:

azimuthally, one is approximately 8 degrees to the left of and the other is approximately 8 degrees to the right of the 12 o'clock position of a listener; and

elevationally, both are positioned substantially on a horizontal plane that intersects the listener's ears;

a second two of said speakers are positioned so that:

azimuthally, one is approximately 45 degrees to the left of and the other is approximately 45 degrees to the right of the 12 o'clock position of the listener; and

elevationally, both are positioned substantially on said horizontal plane;

a third two of said speakers are positioned so that:

azimuthally, one is approximately 135 degrees to the left of and the other is approximately 135 degrees to the right of the 12 o'clock position of the listener; and

elevationally, both are positioned substantially on said horizontal plane;

a fourth two of said speakers are positioned so that:

azimuthally, one is approximately 90 degrees to the left of and the other is approximately 90 degrees to the right of the 12 o'clock position of the listener; and

elevationally, both are positioned above said horizontal plane;

and

a fifth two of said speakers are positioned so that:

azimuthally, one is approximately 90 degrees to the left of and the other is approximately 90 degrees to the right of the 12 o'clock position of the listener; and

elevationally, both are positioned below said horizontal plane.

18. The system of Claim 17 further comprising at least two additional speakers.

19. The system of Claim 18 wherein:

a sixth two of said speakers are positioned so that:

azimuthally, one is approximately 172 degrees to the left of and the other is approximately 172 degrees to the right of the 12 o'clock position of a listener; and

elevationally, both are positioned substantially on a horizontal plane that intersects the listener's ears;

20. A system for providing an encoded signal ("S_{out}") representative of an input sound field, comprising:

a microphone array for receiving the input sound field and producing therefrom a microphone signal ("P_{in}") representative of the input sound field wherein P_{in} comprises B-format channels, an FL (front left) channel, and an FR (front right) channel;

an encoder for producing S_{out} from P_{in} wherein S_{out} comprises an ITU-compatible six channel signal.

21. The system of Claim 20 wherein the hybrid microphone array is comprised of:

at least 6 microphones; and

a baffle including a substantially ellipsoidal structure.

22. The system of Claim 21 wherein four of said microphones are arranged in a tetrahedron.

23. The system of Claim 20 wherein P_{in} and S_{out} are each a 6 x 1 matrix and the encoder produces S_{out} by multiplying P_{in} by a 6 x 6 transformation matrix ("S").

24. The system of Claim 20 wherein S comprises the quantities:

$$\begin{vmatrix} s(L,FL) & s(L,FR) & s(L,W) & s(L,X) & s(L,Y) & s(L,Z) \\ s(R,FL) & s(R,FR) & s(R,W) & s(R,X) & s(R,Y) & s(R,Z) \\ s(C,FL) & s(C,FR) & s(C,W) & s(C,X) & s(C,Y) & s(C,Z) \\ s(SC,FL) & s(SC,FR) & s(SC,W) & s(SC,X) & s(SC,Y) & s(SC,Z) \\ s(SL,FL) & s(SL,FR) & s(SL,W) & s(SL,X) & s(SL,Y) & s(SL,Z) \\ s(SR,FL) & s(SR,FR) & s(SR,W) & s(SR,X) & s(SR,Y) & s(SR,Z) \end{vmatrix}$$

wherein:

L represents a left speaker channel for an ITU-compatible six channel signal;

R represents a right speaker channel for an ITU-compatible six channel signal;

C represents a center speaker channel for an ITU-compatible six channel signal;

SC represents a surround center speaker channel for an ITU-compatible six channel signal;

SL represents a surround left speaker channel for an ITU-compatible six channel signal;

SR represents a surround right speaker channel for an ITU-compatible six channel signal;

FL represents the front left speaker channel;

FR represents the front right speaker channel;

W represents a B-format channel;

X represents a B-format channel;

Y represents a B-format channel;

Z represents a B-format channel;

and wherein

$s(\alpha, \beta)$ represents a transformation quantity relating the respective α and β channels.

25. The system of Claim 24 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.736	0	.425
0	0	.601	−.736	0	.425
0	0	.601	−.368	.638	−.425
0	0	.601	−.368	−.638	−.425

26. The system of Claim 24 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.736	0	−.425
0	0	.601	−.736	0	−.425
0	0	.601	−.368	.638	.425
0	0	.601	−.368	−.638	.425

27. The system of Claim 24 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.736	0	.425
0	0	.601	−.425	0	.736
0	0	.601	−.425	.736	0
0	0	.601	−.425	−.736	0

28. The system of Claim 24 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.850	0	0
0	0	.601	−.425	0	.736
0	0	.601	−.531	.638	−.184
0	0	.601	−.531	−.638	−.184

29. The system of Claim 24 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.425	0	−.736
0	0	.601	−.850	0	0
0	0	.601	−.106	.638	.552
0	0	.601	−.106	−.638	.552

30. The system of Claim 24 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.850	0	0
0	0	.601	0	0	.850
0	0	.601	−.368	.736	.213
0	0	.601	−.368	−.736	.213

31. The system of Claim 23 wherein P_{out} is a 6 x 1 matrix and the decoder produces P_{out} by multiplying S_{out} by the inverse of S.

32. A method for producing an output sound field that is representative of an input sound field, comprising the steps of:

providing a microphone array for receiving the input sound field and producing therefrom a microphone signal ("P_{in}") representative of the input sound field wherein P_{in} comprises B-format channels, an FL channel, and an FR channel;

producing an encoded signal ("S_{out}") from P_{in} wherein S_{out} comprises an ITU-compatible six channel signal;

producing a decoded signal ("P_{out}") from S_{out} wherein P_{out} comprises B-format channels, an FL channel, and an FR channel; and

providing a plurality of speakers for producing the output sound field from P_{out} to thereby represent the input sound field.

33. The method of Claim 32 wherein the hybrid microphone array is comprised of:

at least 6 microphones; and

a substantially ellipsoidal baffle.

34. The method of Claim 33 wherein four of said microphones are arranged in a tetrahedron.

35. The method of Claim 34 wherein the plurality of speakers produces the output sound field from S_{out}.

36. The method of Claim 35 wherein the plurality of speakers are provided in a 2D arrangement.

37. The method of Claim 32 wherein P_{in} and S_{out} are each a 6 x 1 matrix and the encoder produces S_{out} by multiplying P_{in} by a 6 x 6 transformation matrix ("S").

38. The method of Claim 32 wherein S comprises the quantities:

$$\begin{vmatrix} s(L,FL) & s(L,FR) & s(L,W) & s(L,X) & s(L,Y) & s(L,Z) \\ s(R,FL) & s(R,FR) & s(R,W) & s(R,X) & s(R,Y) & s(R,Z) \\ s(C,FL) & s(C,FR) & s(C,W) & s(C,X) & s(C,Y) & s(C,Z) \\ s(SC,FL) & s(SC,FR) & s(SC,W) & s(SC,X) & s(SC,Y) & s(SC,Z) \\ s(SL,FL) & s(SL,FR) & s(SL,W) & s(SL,X) & s(SL,Y) & s(SL,Z) \\ s(SR,FL) & s(SR,FR) & s(SR,W) & s(SR,X) & s(SR,Y) & s(SR,Z) \end{vmatrix}$$

wherein:

L represents a left speaker channel for an ITU-compatible six channel signal;

R represents a right speaker channel for an ITU-compatible six channel signal;

C represents a center speaker channel for an ITU-compatible six channel signal;

SC represents a surround center speaker channel for an ITU-compatible six channel signal;

SL represents a surround left speaker channel for an ITU-compatible six channel signal;

SR represents a surround right speaker channel for an ITU-compatible six channel signal;

FL represents the front left speaker channel;

FR represents the front right speaker channel;

W represents a B-format channel;

X represents a B-format channel;

Y represents a B-format channel;

Z represents a B-format channel;

and wherein

$s(\alpha, \beta)$ represents a transformation quantity relating the respective α and β channels.

39. The method of Claim 38 wherein S comprises the following approximate quantities:

$$\begin{vmatrix} .850 & 0 & 0 & 0 & 0 & 0 \\ 0 & .850 & 0 & 0 & 0 & 0 \\ 0 & 0 & .601 & .736 & 0 & .425 \\ 0 & 0 & .601 & -.736 & 0 & .425 \\ 0 & 0 & .601 & -.368 & .638 & -.425 \\ 0 & 0 & .601 & -.368 & -.638 & -.425 \end{vmatrix}$$

40. The method of Claim 38 wherein S comprises the following approximate quantities:

$$\begin{vmatrix} .850 & 0 & 0 & 0 & 0 & 0 \\ 0 & .850 & 0 & 0 & 0 & 0 \\ 0 & 0 & .601 & .736 & 0 & -.425 \\ 0 & 0 & .601 & -.736 & 0 & -.425 \\ 0 & 0 & .601 & -.368 & .638 & .425 \\ 0 & 0 & .601 & -.368 & -.638 & .425 \end{vmatrix}$$

41. The method of Claim 38 wherein S comprises the following approximate quantities:

$$\begin{vmatrix} .850 & 0 & 0 & 0 & 0 & 0 \\ 0 & .850 & 0 & 0 & 0 & 0 \\ 0 & 0 & .601 & .736 & 0 & .425 \\ 0 & 0 & .601 & -.425 & 0 & .736 \\ 0 & 0 & .601 & -.425 & .736 & 0 \\ 0 & 0 & .601 & -.425 & -.736 & 0 \end{vmatrix}$$

42. The method of Claim 38 wherein S comprises the following approximate quantities:

$$\begin{vmatrix} .850 & 0 & 0 & 0 & 0 & 0 \\ 0 & .850 & 0 & 0 & 0 & 0 \\ 0 & 0 & .601 & .850 & 0 & 0 \\ 0 & 0 & .601 & -.425 & 0 & .736 \\ 0 & 0 & .601 & -.531 & .638 & -.184 \\ 0 & 0 & .601 & -.531 & -.638 & -.184 \end{vmatrix}$$

43. The method of Claim 38 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.425	0	−.736
0	0	.601	−.850	0	0
0	0	.601	−.106	.638	.552
0	0	.601	−.106	−.638	.552

44. The method of Claim 38 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.850	0	0
0	0	.601	0	0	.850
0	0	.601	−.368	.736	.213
0	0	.601	−.368	−.736	.213

45. The method of Claim 37 wherein P_{out} is a 6 x 1 matrix and the decoder produces P_{out} by multiplying S_{out} by the inverse of S.

46. The method of Claim 32 wherein the plurality of speakers are arranged in a 3D arrangement.

47. The method of Claim 46 wherein the plurality of speakers is ten.

48. The method of Claim 47 wherein:

a first two of said speakers are positioned so that:

azimuthally, one is approximately 8 degrees to the left of and the other is approximately 8 degrees to the right of the 12 o'clock position of a listener; and

elevationally, both are positioned substantially on a horizontal plane that intersects the listener's ears;

a second two of said speakers are positioned so that:

azimuthally, one is approximately 45 degrees to the left of and the other is approximately 45 degrees to the right of the 12 o'clock position of the listener; and

elevationally, both are positioned substantially on said horizontal plane;

a third two of said speakers are positioned so that:

azimuthally, one is approximately 135 degrees to the left of and the other is approximately 135 degrees to the right of the 12 o'clock position of the listener; and

elevationally, both are positioned substantially on said horizontal plane;

a fourth two of said speakers are positioned so that:

azimuthally, one is approximately 90 degrees to the left of and the other is approximately 90 degrees to the right of the 12 o'clock position of the listener; and

elevationally, both are positioned above said horizontal plane;

and

a fifth two of said speakers are positioned so that:

azimuthally, one is approximately 90 degrees to the left of and the other is approximately 90 degrees to the right of the 12 o'clock position of the listener; and

elevationally, both are positioned below said horizontal plane.

49. The method of Claim 48 further comprising at least two additional speakers.

50. The method of Claim 49 wherein:

a sixth two of said speakers are positioned so that:

azimuthally, one is approximately 172 degrees to the left of and the other is approximately 172 degrees to the right of the 12 o'clock position of a listener; and

elevationally, both are positioned substantially on a horizontal plane that intersects the listener's ears;

51. A method for producing an encoded signal ("S_{out}") representative of an input sound field, comprising the steps:

providing a microphone array for receiving the input sound field and producing therefrom a microphone signal ("P_{in}") representative of the input sound field wherein P_{in} comprises B-format channels, an FL (front left) channel, and an FR (front right) channel;

producing S_{out} from P_{in} wherein S_{out} comprises an ITU-compatible six channel signal.

52. The method of Claim 51 wherein the hybrid microphone array is comprised of:

at least 6 microphones; and

a substantially ellipsoidal shaped baffle.

53. The method of Claim 52 wherein four of said microphones are arranged in a tetrahedron.

54. The method of Claim 51 wherein P_{in} and S_{out} are each a 6 x 1 matrix and the encoder produces S_{out} by multiplying P_{in} by a 6 x 6 transformation matrix ("S").

55. The method of Claim 51 wherein S comprises the quantities:

$$\begin{vmatrix} s(L,FL) & s(L,FR) & s(L,W) & s(L,X) & s(L,Y) & s(L,Z) \\ s(R,FL) & s(R,FR) & s(R,W) & s(R,X) & s(R,Y) & s(R,Z) \\ s(C,FL) & s(C,FR) & s(C,W) & s(C,X) & s(C,Y) & s(C,Z) \\ s(SC,FL) & s(SC,FR) & s(SC,W) & s(SC,X) & s(SC,Y) & s(SC,Z) \\ s(SL,FL) & s(SL,FR) & s(SL,W) & s(SL,X) & s(SL,Y) & s(SL,Z) \\ s(SR,FL) & s(SR,FR) & s(SR,W) & s(SR,X) & s(SR,Y) & s(SR,Z) \end{vmatrix}$$

wherein:

L represents a left speaker channel for an ITU-compatible six channel signal;

R represents a right speaker channel for an ITU-compatible six channel signal;

C represents a center speaker channel for an ITU-compatible six channel signal;

SC represents a surround center speaker channel for an ITU-compatible six channel signal;

SL represents a surround left speaker channel for an ITU-compatible six channel signal;

SR represents a surround right speaker channel for an ITU-compatible six channel signal;

FL represents the front left speaker channel;

FR represents the front right speaker channel;

W represents a B-format channel;

X represents a B-format channel;

Y represents a B-format channel;

Z represents a B-format channel;

and wherein

$s(\alpha, \beta)$ represents a transformation quantity relating the respective α and β channels.

56. The method of Claim 55 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.736	0	.425
0	0	.601	−.736	0	.425
0	0	.601	−.368	.638	−.425
0	0	.601	−.368	−.638	−.425

57. The method of Claim 55 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.736	0	−.425
0	0	.601	−.736	0	−.425
0	0	.601	−.368	.638	.425
0	0	.601	−.368	−.638	.425

58. The method of Claim 55 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.736	0	.425
0	0	.601	−.425	0	.736
0	0	.601	−.425	.736	0
0	0	.601	−.425	−.736	0

59. The method of Claim 55 wherein S comprises the following approximate quantities:

.850	0	0	0	0	0
0	.850	0	0	0	0
0	0	.601	.850	0	0
0	0	.601	−.425	0	.736
0	0	.601	−.531	.638	−.184
0	0	.601	−.531	−.638	−.184

60. The method of Claim 55 wherein S comprises the following approximate quantities:

$$\begin{vmatrix} .850 & 0 & 0 & 0 & 0 & 0 \\ 0 & .850 & 0 & 0 & 0 & 0 \\ 0 & 0 & .601 & .425 & 0 & -.736 \\ 0 & 0 & .601 & -.850 & 0 & 0 \\ 0 & 0 & .601 & -.106 & .638 & .552 \\ 0 & 0 & .601 & -.106 & -.638 & .552 \end{vmatrix}$$

61. The method of Claim 55 wherein S comprises the following approximate quantities:

$$\begin{vmatrix} .850 & 0 & 0 & 0 & 0 & 0 \\ 0 & .850 & 0 & 0 & 0 & 0 \\ 0 & 0 & .601 & .850 & 0 & 0 \\ 0 & 0 & .601 & 0 & 0 & .850 \\ 0 & 0 & .601 & -.368 & .736 & .213 \\ 0 & 0 & .601 & -.368 & -.736 & .213 \end{vmatrix}$$

62. The method of Claim 54 wherein P_{out} is a 6 x 1 matrix and the decoder produces P_{out} by multiplying S_{out} by the inverse of S.

63. In a system for producing a 2D output sound field that is a function of an input sound field, where the system includes a microphone for receiving the input sound field and producing therefrom a microphone signal comprising B-format channels, an encoder for receiving the microphone signal and producing therefrom an encoded signal comprising an ITU-compatible six channel signal, and a first plurality of speakers arranged in a 2D configuration for receiving the encoded signal and producing therefrom the 2D output sound field, the improvement comprising:

a microphone array in place of said microphone wherein said microphone array receives the input sound field and produces therefrom a microphone array signal representative of the input sound field wherein the microphone array signal comprises B-format channels, an FL channel, and an FR channel;

said encoder further comprising circuitry for providing said encoded signal from said microphone array signal;

a decoder for producing a decoded signal from said encoded signal wherein said decoded signal comprises B-format channels, an FL channel, and an FR channel; and

a second plurality of speakers in addition to the first plurality of speakers, said first and second plurality of speakers arranged in a 3D configuration and receiving said decoded signal and producing therefrom a 3D output sound field.

64. The system of Claim 63 wherein the hybrid microphone array is comprised of:

at least 6 microphones; and

a baffle including a substantially ellipsoidal structure.